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## **Toward a Consensus on Centralization in Surgery**

Vonlanthen, René ; Lodge, Peter ; Barkun, Jeffrey S ; et al ; Käser, S A ; Petrowsky, Henrik ; Clavien, Pierre-Alain

**Abstract:** **OBJECTIVES** To critically assess centralization policies for highly specialized surgeries in Europe and North America and propose recommendations. **BACKGROUND/METHODS** Most countries are increasingly forced to maintain quality medicine at a reasonable cost. An all-inclusive perspective, including health care providers, payers, society as a whole and patients, has ubiquitously failed, arguably for different reasons in environments. This special article follows 3 aims: first, analyze health care policies for centralization in different countries, second, analyze how centralization strategies affect patient outcome and other aspects such as medical education and cost, and third, propose recommendations for centralization, which could apply across continents. **RESULTS** Conflicting interests have led many countries to compromise for a health care system based on factors beyond best patient-oriented care. Centralization has been a common strategy, but modalities vary greatly among countries with no consensus on the minimal requirement for the number of procedures per center or per surgeon. Most national policies are either partially or not implemented. Data overwhelmingly indicate that concentration of complex care or procedures in specialized centers have positive impacts on quality of care and cost. Countries requiring lower threshold numbers for centralization, however, may cause inappropriate expansion of indications, as hospitals struggle to fulfill the criteria. Centralization requires adjustments in training and credentialing of general and specialized surgeons, and patient education. **CONCLUSION/RECOMMENDATIONS** There is an obvious need in most areas for effective centralization. Unrestrained, purely "market driven" approaches are deleterious to patients and society. Centralization should not be based solely on minimal number of procedures, but rather on the multidisciplinary treatment of complex diseases including well-trained specialists available around the clock. Audited prospective database with monitoring of quality of care and cost are mandatory.

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# Toward a Consensus on Centralization in Surgery

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**Objectives:** To critically assess centralization policies for highly specialized surgeries in Europe and North America and propose recommendations.

**Background/Methods:** Most countries are increasingly forced to maintain quality medicine at a reasonable cost. An all-inclusive perspective, including health care providers, payers, society as a whole and patients, has ubiquitously failed, arguably for different reasons in environments. This special article follows 3 aims: first, analyze health care policies for centralization in different

countries, second, analyze how centralization strategies affect patient outcome and other aspects such as medical education and cost, and third, propose recommendations for centralization, which could apply across continents.

**Results:** Conflicting interests have led many countries to compromise for a health care system based on factors beyond best patient-oriented care. Centralization has been a common strategy, but modalities vary greatly among countries with no consensus on the minimal requirement for the number of procedures per center or per surgeon. Most national policies are either partially or not implemented. Data overwhelmingly indicate that concentration of complex care or procedures in specialized centers have positive impacts on quality of care and cost. Countries requiring lower threshold numbers for centralization, however, may cause inappropriate expansion of indications, as hospitals struggle to fulfill the criteria. Centralization requires adjustments in training and credentialing of general and specialized surgeons, and patient education.

**Conclusion/Recommendations:** There is an obvious need in most areas for effective centralization. Unrestrained, purely “market driven” approaches are deleterious to patients and society. Centralization should not be based solely on minimal number of procedures, but rather on the multidisciplinary treatment of complex diseases including well-trained specialists available around the clock. Audited prospective database with monitoring of quality of care and cost are mandatory.

**Keywords:** centralization, costs, quality

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Almost all countries worldwide are facing major challenges with their health care system and related costs. The topic is complex due to numerous factors and perspectives involved in a network of health care policies, which are determined by various players, including politicians, insurance or other payers, hospitals, physicians, and national medical societies. Those policies mirror country-specific social values and available resources. Surprisingly, patients are rarely in the center of the debate, although an emerging perspective, known as value-based medicine, is gaining increasing attention. Value-based medicine aims at measuring quality of care with endpoints relevant to patients and society as a whole.<sup>1,2</sup>

Although quality of care at acceptable costs is ubiquitously the target of accountable health care systems, the definition of quality remains imprecise, and therefore subjected to versatile interpretation, or even manipulation, depending on the perspectives. For example, a country might be satisfied with a goal of spending less than 10% of gross domestic product (GDP), while another may value offering free health care to all its inhabitants. An important topic, currently under scrutiny in most countries, is how to provide complex procedural care

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to their populations with laws or policies ranging from unregulated free markets to concentration in a single national center.

The European Surgical Association (ESA) is selecting every year a special topic and lecture of high relevance, preferentially not only for surgeons but also for the society as a whole. This year, the focus is on centralization for complex surgical procedures. Centralization in surgery is a process of concentration of resources, which includes infrastructure, staff, material, knowledge, and research. This process should lead to improved quality of care and eventually increased financial efficiency. How centralization should be implemented remains difficult, as an all-inclusive perspective has ubiquitously failed.

The first relevant description of a relationship between higher surgical volume and postoperative mortality was reported in 1979 for 12 surgical procedures<sup>3</sup> followed by a description of factors associated with higher mortality rates.<sup>4</sup> Today, many elements have been established in the surgical field, which are associated with incremental improvements in the quality of health care.<sup>5</sup> One repetitive observation is that high-volume institutions are associated with improved outcome through better knowledge about proper indications, surgical procedures, and postoperative care.<sup>6,7</sup> Another feature associated with better outcome is the so-called “rescue phenomenon” meaning the ability to prevent minor postoperative events to develop to severe complications and eventually death.<sup>8</sup>

Surprisingly, nearly 40 years after the original publication,<sup>3</sup> the process of centralization has not progressed much, although the topic is increasingly recognized as important. For example, 6 (15%) of the 40 original presentations this year at ESA are dedicated to centralization. This special article follows 3 aims: first, to analyze health care delivery in Europe and North America with a focus on centralization for complex surgical procedures; second, to analyze the impact of centralization on outcome based on all available data on centralization, with a special focus on 2 specific procedures (pancreas and esophagus resections), as well as its influence on education and cost; and third to propose recommendations for the optimal delivery of complex procedures using a Delphi process among ESA members.

## STUDY DESIGN

Our primary goal was to analyze country-specific strategies of centralization and their impact on outcomes in surgery. For this purpose, information on this topic was retrieved from the World Wide Web, available literature, and country-specific reviews and national databases. The literature search was based on the PubMed database and cross-reference methodology. The resulting information was presented to a panel of academic surgeons, mostly ESA members, to propose recommendations for effective centralization using a Delphi methodology.

### Country-specific Analysis

Twenty European countries as well as the USA and Canada were searched for (1) centralization policies, (2) organization of centralized health care delivery, and (3) minimal case thresholds with a special focus on major abdominal surgeries, including liver, esophagus, pancreas, and rectal resections. Each country-specific analysis was conducted mostly with a nominated country representative ESA member.

### Outcome-oriented Analysis of Centralization

The effects of hospital and surgeon volume as well as specialized training on surgical outcome were analyzed. Mortality and morbidity rates, length of hospital stay, and rates on failure to rescue from complications were selected to measure the effect of centralization. These measures were extracted from actual papers and meta-

analysis studies and the effect size are given as odds ratio (OR) or hazard ratio (HR) with 95% confidence interval (95% CI). In addition, a comprehensive outcome analysis with examples in different countries was carried out for two complex gastrointestinal procedures: esophageal and pancreatic resection.

### Perspective-oriented Search on Centralization

A PubMed search was conducted to better understand the patients' and surgeons' perspective on centralization issues. Furthermore, a survey among active ESA members was conducted in order to find out their attitude to important factors of centralization.

### Delphi Method

A second survey was embedded in the Delphi methodology<sup>9,10</sup> to propose recommendations for future development strategies in centralization. The Delphi method is a systematic interactive way of gaining opinions from a panel of independent experts over 2 or more rounds of consultations. It is a consensus method, which does not require face-to-face meetings and can be based on online questionnaires. On the basis of all the information available for the preparation of this manuscript, a 3-step Delphi process was performed among all coauthors, which includes 1 representative from each country involved in the analysis.

## CENTRALIZATION POLICIES IN EUROPE AND NORTH AMERICA

In a first step, we analyzed the centralization policies in gastrointestinal (GI) surgery in 20 European countries, Canada, and the USA. Thirteen (65%) from the 20 European countries have related the definition of minimal volume in terms of activity per center for selective procedures, and only 5% (1/20) have proposed minimal case load per surgeon (Table 1). Four countries, the Czech Republic, Greece, Poland, and Romania, have currently no policy regarding centralization in GI surgery.

There is a lack of consistence in the way health care policy makers, typically national and regional governments, define procedures or diseases to be centralized. Austria, Denmark, and Switzerland, for example, based their choices for centralization on rarity of disease, complexity with high postoperative morbidity, structural requirements, and consequently costs, and, when available on evidence for a volume-outcome relationship. In other countries, complexity, management with multiple disciplines, and technical challenges of the procedures followed by the financial burden are the most common selection criteria, recognizing a need for centralization for procedures on the esophagus, pancreas, liver, and rectum. Centralization policies may either relate to procedures on an organ, or be restricted to specific cancers, for example, pancreatic cancer, or conditions, such as morbid obesity.

There is an obvious gap between regulations for centralization and implementation. Although centralization is well implemented in the field of transplantation, pediatric, and neurosurgery, the reality is very different for other GI procedures. We document, for example, that volume thresholds in Austria and Germany are not respected in spite of legally defined requirements. Perhaps the most striking deviation is that regulations apply to publicly “subsidized” hospitals but are not enforced in the private sector. Good examples are the UK and Switzerland. Main obstacles to centralization are summarized in Table 2.

A brief comment on each country by alphabetical order followed by Canada and the USA is provided online (<http://links.lww.com/SLA/B467>).<sup>11–19,21–23,25–42,44–49</sup> This additional information can be downloaded as supplementary material online, <http://links.lww.com/SLA/B467>.

**TABLE 1.** Requirement for Minimal Numbers (Resections/Year) Per Center

Country	Esophagus	Pancreas	Liver	Rectum	Surgeon Volume	Legally Enforced
Austria	10	10	10 (20 <sup>2018</sup> )	10 (15 <sup>2018</sup> )	ND	Yes
Belgium	ND	ND	ND	ND	ND	
Czech Republic	ND	ND	ND	ND	ND	
Denmark*	80–100	>100	>200	>120	ND	
England (UK)*	60	80	150	ND	Defined	
Finland	ND	ND	ND	ND	ND	
France†	30	30	30	30	ND	Yes
Germany	10	10	ND	ND	ND	Yes
Greece	15	20	30	ND	ND	
Hungary	10	20	30	20	ND	
Ireland*	ND	ND	ND	ND	ND	
Italy	20	50–100	20	50	ND	
Norway*	10	10	20	20	ND	
Poland	ND	ND	ND	ND	ND	
Portugal	20	20	20	20	ND	
Romania	ND	ND	ND	ND	ND	
Spain	6	11	11	15	ND	Yes
Sweden*	ND	ND	ND	ND	ND	
Switzerland	10	10	10	10	ND	Yes
The Netherlands	20	20	20	20	ND	Yes
Canada	7	20	50	ND	ND	
USA**	20	20	ND	15	Defined	

\*Not based on minimal numbers but defined catchment areas/health care regions; Denmark, England, and Norway have additionally secured minimal numbers.

†In France, minimal number of 30 procedures in total for cancer irrespective of the location.

\*\*According to the Leapfrog Group.

ND indicates not defined.

Additional information can be downloaded as supplementary material online, <http://links.lww.com/SLA/B467>.

## THE IMPACT OF CENTRALIZATION OF SURGERY ON OUTCOME

The main goals of centralization are the improvement of quality of care, optimization of use of resources, and eventually cost saving. The real impact of centralization on outcome, however, remains vague and is currently under hot debate in many countries. It is unclear whether positive effects of centralization are mainly based on center or surgeon volumes, or also on other factors such as the availability of formally trained specialists. We, therefore,

investigated the impact of center versus surgeon volumes on outcome. Furthermore, we analyzed the effects of centralization in pancreas and esophagus surgery in more detail.

### Effect of Hospital Volume

Available data correlating center volume with outcome parameters are mainly based on statistics derived from both retrospective and prospective studies. Of note, positive effects of hospital volume were less pronounced in prospective (40%) than in retrospective (79%) studies. For the current analysis, we used mostly 3 systematic reviews and meta-analysis.<sup>51–53</sup>

The first observation was that no study identified inferior outcome for high-volume centers, when compared with low-volume centers, while 74% reported positive effects. These effects were mirrored in many outcome measures, including mortality rates (positive effect in 76% of the studies), morbidity (62%), and shorter hospital stay (79%). The magnitude of positive effects also varied among the different types of procedures ranging between 62% and 85%, which were most evident for esophageal and pancreatic surgery. From these consistent observations, the logical question is: what is the volume cut-off associated with improved outcome? There is a wide range of proposed cut-offs for high-volume centers ranging from 21 to 50 cases/year for pancreatic resection, 6 to 30 for esophageal cancer, and 11 to 70 for colorectal resections. These wide ranges indicate that other key factors play an important role for the positive impact of centralization. Therefore, centralization policies focusing exclusively on volume might not translate to an optimal benefit. There is some evidence that when hospital volume reaches a certain threshold, the volume outcome effect reaches a plateau, which then can even be associated with higher mortality rates (Fig. 1).<sup>54–56</sup>

### Effect of Surgeon Volume

The association of surgeon volume and outcome is less often reported in the literature, when compared with hospital volume. The inaugural work by Birkmeyer et al<sup>57</sup> suggested that surgeon volume

**TABLE 2.** Main Obstacles to Centralization

<b>(1) At the level of the health care provider (eg, hospital)</b>
Insufficient infrastructure
Lack of specialized personnel
Long waiting time
Difficult access to a center
Restriction of working hours
<b>(2) At the level of the patient</b>
Resistance to longer travel distance
Resistance to cultural changes (eg, language)
Lack of awareness of better outcome
<b>(3) At the level of the payer (insurance, government)</b>
Concerns from increased cost or charges
<b>(4) At the political level (government, professional societies)</b>
Political decision is not enforced and therefore not applied
Regional interests overcome centralization policies
Discrepancies between public law and civil law (ie, private hospitals are not under the public law, noncompetition clause not possible in nonprivate hospitals)
Conflict of interest between societies (eg, specialized vs general surgeons)
Overwhelming bureaucracy (audit, certification, registries, CME, etc)
Lack of specialization boards
Lack of board recognition among countries



accounts for a large proportion of the significant effects of hospital volume; for example, in pancreatic surgery, 55% of the improvement was attributed to surgeon volume, and 46% in esophagectomy. After adjusting for the clustering effects in other studies, the short-term mortality risk is surprisingly not significantly associated with surgeon volume, in contrast to the long-term results.<sup>58</sup> Obviously, both surgeon and center volumes influence patient outcomes, but the strength of the relationship varies according to the complexity of the surgery and the extent of specific hospital-based services. Esophageal and pancreatic head resections are complex procedures, whereas, for example, distal pancreatectomies are less complex to perform, and liver surgery varies from small wedge resections to extended hemi-hepatectomies. Therefore, the type of operation should be taken into account when calculating morbidity and mortality rates, though often complexity of the procedure is not stated and consequently not included in the risk adjustment. There are important hospital factors, which may add to the impact of center volume. For example, resources allocated to intensive care units (ICUs) differ between countries, with variation in the ratios of total hospital beds to ICU beds and of nurses to patients ranging from 1:1 to 1:3. Clearly, the availability of ICU and well-trained staff impact on outcome, and particularly in the “failure-to-rescue” concept. Furthermore, the qualifications of care providers and surgeons are not documented.<sup>59</sup>

When focusing on surgeon volume only, positive effects on outcome were observed in 74% of studies, including lower mortality rates (in 71% of studies), fewer complications (81%), and shorter hospital stay (78%). In addition, no study identified negative effects of high surgeon volume on outcome.<sup>51</sup> However, an evidence-based surgeon volume threshold cannot be identified. The cut-offs for high surgeon volume vary in the literature between 4 and 41 cases/year for pancreatic surgery, 6 and 12 for esophageal resections, and 13 and 33 for colorectal cancer resections. Of note, an increased hospital volume compensates to certain degree for low-volume surgeons, but possibly never matching those of high-volume surgeons.<sup>60</sup>

### Effect of Specialization

Over the past 2 to 3 decades, formal specialization in specific fields of surgery including dedicated periods of training at expert centers have been developed in many countries with the availability in Europe and North America of board examinations and certification. The benefit of such training on patient outcome is now established through many studies. In a systematic review,<sup>51</sup> such benefit was evident in the majority of studies (91%), as demonstrated by lower mortality, shorter hospital stay, fewer complication rates, and interestingly enhanced academic output, for example, in terms of publications.

Taken together, it is now established that hospital-surgeon volumes and specialization are the 3 predominant elements influencing outcome, but the underlying mechanisms are not fully explored. Two factors regarding volume effect have been proposed: first the so-called “selective referral effect” to experienced physicians and hospitals because of better outcomes. In this scenario, better outcome is mostly unrelated to the number of cases. Second, relies on “practice-makes perfect,” where providers achieve better outcomes because of increased experience due to more volume. Both explanations have proven to be valid.<sup>61</sup> Thus, volume and specialization alone may not result in better performance, but act as a proxy measure for various processes and provider characteristics that eventually positively influence outcomes.<sup>6</sup> Another mechanism for improved outcome at larger centers is the concept of “failure-to-rescue.” Although low and high-volume hospitals may have comparable complication rates, high-volume hospitals have a 2.5x lower mortality rate. One rational explanation is that low-volume hospitals

manage complications poorly. Furthermore, it has been shown, that low versus high mortality “failure-to-rescue” hospitals tended to have a closed ICU staffing model (56% vs 20%), as well as a higher proportion of board-certified intensivists (85% vs 20%), hospitalists (85% vs 20%), and residents (62% vs 40%). Low mortality “failure-to-rescue” hospitals provide a better overnight coverage with timely dedicated response teams.<sup>62</sup>

After discharge of the patient, hospital readmissions logically occur more frequently after complex surgeries. Interestingly, readmission to the index hospital (hospital where the surgery was done) is associated with a 26% lower risk of 90-day mortality than readmission to a nonindex (ie, nonspecialized) hospital. This effect was significant ( $P < 0.0001$ ) for all procedures and accounts at largest for patients, who are readmitted after pancreatectomy (OR 0.56, 95% CI 0.45–0.69).<sup>63</sup>

### The Case of Esophageal Surgery

In-hospital mortality for esophageal cancer resection ranges in national outcome studies between 7% and 12%.<sup>56,64</sup> Overall esophageal tumor prognosis remains poor with a 5-year survival in the range of 20% to 30%.<sup>56</sup> Surgery on the esophagus represents the most robust evidence for a reduction in postoperative mortality and morbidity by concentration of cases in high-volume centers, with very large centers associated with 1% to 4% mortality rates.<sup>65–67</sup> A meta-analysis covering 16 studies enabled to demonstrate significant favorable postoperative mortality rates for high-volume providers (OR, 2.30; 95% CI, 1.89–2.80). Four studies additionally showed long-term survival benefit for high-volume centers (HR 1.17; 95% CI, 1.05–1.30).<sup>68</sup>

A meta-analysis reported in 2004 suggested that a benefit in postoperative mortality occurs when using a volume threshold of at least 20 esophagectomies/year.<sup>65</sup> In another study, increasing hospital volume from 20/year to 40 and then 60/year led to incremental significant decrease in 6-month mortality [HR 0.73 (95% CI 0.65–0.83) vs 0.67 (0.58–0.77)]. Beyond the threshold of 60 resections per year, however, no further effect size might occur.<sup>54</sup> In the same study, higher hospital volume was associated with lower 2-year mortality up to 50 esophagectomies/year with HR of 0.6 (95% CI 0.79–0.93). Although it remains unclear where the volume bar for safer esophageal resection should be set, based on the available data, the bar for high-volume centers for esophageal resections seems to range between 20 and 60 resections/year. It appears, however, that there may be a reversal of these positive volume-outcome associations when hospital volume exceeds 100 cases/year due to some evidence for rising mortality rates after this threshold (Fig. 1).<sup>56</sup> Studies have suggested that for esophagectomy, the relation between hospital volume and outcome is stronger than that of surgeon volume.<sup>57,65</sup>

Two countries were selected, Germany and Switzerland, to illustrate the volume outcome effects in esophageal surgery. Further, a comparative national study for esophageal resections between England (centralized) and the USA (decentralized) was included. Among 18,000 patients (data from 2009 to 2014) undergoing esophageal resection for carcinoma in Germany, adjusted mortality rate was 5.8% (95% CI 5.1–6.6) on the very high-volume quintile versus 10.5% (95% CI 9.5–11.6) in the very low quintile. Hospital volume had an independent effect on mortality, and the minimum volume to fall below the average mortality of 8.5% was calculated as 22 cases per year.<sup>69</sup> A total of 1487 esophageal cancer resections were performed in Switzerland from 1999 to 2012. The decrease of postoperative mortality from low-volume ( $\leq 10$  cases/year) to higher volume centers ( $\geq 11$  cases/year) was 6.3% versus 3.3%. These results were confirmed in risk-adjusted analyses with a decreased odds of postoperative death by 49% (OR 0.51, 95% CI 0.22–1.18;  $P = 0.085$ ).<sup>43</sup>

The comparison of the in-hospital mortality and length of stay after esophagectomy between England and the United States deserves a comment.<sup>70</sup> Surgery on the esophagus have been centralized in England since 2001, while no formal plan for centralization exists in the USA. As a result, between 2005 and 2010, 7433 esophagectomies were performed in 66 English hospitals and 5858 resections in 775 US hospitals (Nationwide Inpatient Sample; NIS); the median number of resections per center/year was 17.5 in England versus 2 in the USA. In-hospital mortality was higher in US hospitals (5% vs 4%,  $P = 0.001$ ). When a subset analysis was done restricted to high-volume centers, mortality was significantly better in US hospitals (2.1% vs 3.5%,  $P = 0.02$ ) with shorter LOS in the US high-volume centers, but not in England.

### The Case of Pancreatic Surgery

Pancreatic surgery is one of the most sensitive procedures to the effect of centralization.<sup>71,72</sup> Mortality rates in specialized centers range between 0% and 5%,<sup>20,24,73</sup> but are twice as high in population-based studies reflecting the real risk of pancreatic procedures at nonspecialized centers.<sup>20,74</sup> The underestimation of the real risk has been repeatedly observed.<sup>20,75,76</sup> A systematic review of studies adjusted for age and comorbidities showed a significant association between hospital volume and postoperative mortality (OR 0.32, 95% CI 0.16–0.64), as well as long-term survival (HR 0.79, 95% CI 0.70–0.89).<sup>77</sup> Positive effects of high-volume centers have also been shown for postoperative complications, readmission rates, and failure to rescue.<sup>78,79</sup> Similar to esophageal surgery, the volume cut-offs for high-volume centers remains under debate. A national French study used sophisticated methodology (spline analysis) to look at minimal volume for better outcome and identified 2 cut-offs (25 and 65 cases per year).<sup>20</sup> A cut-off at 65 pancreatectomies per year best influenced the 90-day mortality. Taking centers performing >65 resections per year as baseline, the adjusted OR of 90-day mortality was 1.86 (95% CI 1.53–2.28) in centers performing ≤25 resections per year and 1.23 (95% CI 1.03–1.48) in those performing 26 to 65 resections per year. Consequently, the second cut-off point is recommended at 25 resections/year giving policy makers and surgeons realizable goals without abrupt change.

To illustrate volume-outcome effects in pancreatic surgery on national levels, Germany, Switzerland, and The Netherlands were selected. In Germany, between 2009 and 2014 pancreatic cancer resections were performed in 35,000 patients with an adjusted in-hospital mortality of 6.4% (95% CI 5.8–7.0) in the very high-volume quintile versus 11.7% (95% CI 10.9–12.5) in the low quintile. The continuous increment of hospital volume was associated with lower mortality. The minimum volume, in which the risk of death falls below the average mortality of 8.8%, was calculated at 29 cases/year.<sup>69</sup> In Switzerland, a total of 2668 pancreatic cancer resections were performed between 1999 and 2012. Low-volume centers (≤20 cases/year) demonstrated a higher postoperative mortality rate of 5.4% than 2% for higher volume centers (≥21 cases/year). These results were also confirmed in a risk-adjusted analysis with a 65% lower odds of postoperative death (OR 0.32, 95% CI 0.11–0.89;  $P = 0.011$ ).<sup>43</sup>

In the Netherlands, a 10-year lasting plea for centralization among the surgical community for pancreatic resections, set in 2005, failed to reduce mortality, likewise due to a failure in changing the referral pattern.<sup>80</sup> One year later, the network of surgical oncologists in the Western part of the Netherlands agreed to centralize all pancreatic resection in 2 hospitals, which resulted in an increase of the 2-year survival rates from 39% to 55%.<sup>81</sup> Another important data from the Dutch Cancer Registry indicated increased resectability rates by centralization policies from 10.7% to 15.3%.<sup>82</sup> At the same time, high-volume hospitals reported more R0 resections in the

pancreatic head and distal bile duct tumors than low-volume hospitals (60% vs 54%,  $P = 0.035$ ), even though they obviously operated on more advanced tumors (T3/T4) (72% vs 58%,  $P < 0.001$ ).<sup>55</sup> In another recent Dutch study, the mortality rate for pancreatic resections decreased nationwide from 9.8% to 5.1% due to centralization.<sup>83</sup> Nonetheless, the surgical community has come to embrace the principles and advantages of centralization, although many believe the threshold of 20 procedures should be increased.

### THE IMPACT OF CENTRALIZATION ON SURGICAL TRAINING

It is difficult to move toward centralization without facing new challenges for proper training of both general and specialized surgeons, as well as for other fields in medicine. For example, the numbers of hospitals in Germany performing esophageal and pancreatic surgery decreased, by 44% and 28% within a short period, respectively.<sup>84</sup> Similarly, the Netherlands showed a similar trend with a significant reduction of hospitals from 160 in 1985 to 79 in 2016. These developments imply that highly specialized procedures restricted to some centers should be included in the Board of General or Visceral Surgery. Such procedures should be performed exclusively by surgeons with extra, and possibly, accredited training in a specific area of surgery. The “Union Européenne des Médecins Spécialistes” (UEMS; [www.uems.eu](http://www.uems.eu)) recognized this issue, proposing a “grapefruit” training model starting with a basic training in surgery as a foundation to which individual surgeons can add 1 or more specialties.

However, proper training appears only possible through formal fellowship periods at qualified centers. According to the American College of Surgeons (<https://www.facs.org/education/resources/medical-students/postres>), fellowship training allows the trainee during a designated period (usually 1 to 2 years) to attain additional training in a surgical specialty, which is beyond the covered intensity during residency training. The UEMS offers board examinations for various specialties such as colorectal, HPB, or transplantation surgery. The focus of these examinations is on knowledge in indications and management of complications in the respective fields of surgery. Usually 2 years of specialty training are required before being allowed access to the examination. However, accreditation of training programs with formalized and quality-controlled fellowship training is still in early development, and do not secure competence in performing highly complex procedures. It is essential that fellows during training are given access to sufficient numbers of cases and variation of operations, including management of complications, and exposure to scientific work in the field. After this specialized training, fellows must be integrated in a specialized team to get further mentorship and support.

The need for designated and specialized post-residency training is evident in the USA with more than 70% of residents entering a formal training program in a surgical specialty after residency.<sup>85</sup> Importantly, training of young surgeons for complex surgeries through formal fellowship or even residency programs has no negative impact on patient outcome including mortality and morbidity.<sup>56</sup> In fact, a formal training offers a number of positive effects for the care of patients at many levels.

General surgeons, however, still perform the vast majority of cancer surgeries, which obviously are not restricted to large institutions due to logistic and many other reasons. Therefore, an adequate balance of generalized and specialized surgeons must be well planned in all health care systems to maintain accessibility to high-quality health care in all geographic areas in a country. Networking between highly specialized institutions and other hospitals is a key factor to optimize accessibility of care to patients.

The tremendous and incessant advances in novel technology (eg, robotics) requires continuous adjustments in knowledge to secure optimal care, best available at centralized institution. Here, the importance of postgraduate education and the increasing need for training and accreditation for new technical skills cannot be over-emphasized. To achieve decent knowledge in new technology, cooperation among specialized centers, scientific organizations, and industry is paramount.

Finally, working hour restrictions, as regulated in many countries, make an adequate surgical and subspecialty training increasingly difficult, not to say impossible.<sup>85</sup> These factors further support the concept of specialized training in an era of centralization, where complex procedures such as pancreatic or esophageal surgery are assigned to specialized training tracts.

### The Impact of Centralization of Surgery on Cost

One of the aims of centralization, as a consequence of improvement in quality of care, is to be cost neutral, or better cost-saving. High-volume compared with low-volume centers have reduced mortality, morbidity, and “failure-to-rescue” rates,<sup>86–88</sup> which logically impact positively on cost.<sup>89</sup> It has been shown that severe complications ( $\geq$  grade IIIb complications) are the single most important factor affecting total cost of a procedure.<sup>90</sup> For example, in pancreatic surgery, a 5-fold increase in costs was documented in patients developing severe postoperative complications versus those with an uneventful course.<sup>89</sup> The prevention of severe complications, therefore, represents an important economic target for cost-saving.<sup>91</sup> To further illustrate the relation between quality and cost, transthoracic esophagectomy in Germany may serve as a good example: The mean costs per uncomplicated case was reported at 24,338€, which appeared well covered by the DRG system, but not in the presence of postoperative complications. With the development of a grade I complication, DRG system leads to a deficit of 2878€, which increase to 58,543€ in presence of a grade IVb complication. The main cost drivers in case of a complication can be identified as medical services (22.3%; physician work) and nonmedical infrastructure (18.7%) and 56% of costs arise on the ICU and OR (28% each).<sup>92</sup>

Another study analyzing costs for PD in the USA shows that there is a significant cost reduction of 15% (with shorter LOS, fewer ICU admissions), when high-volume surgeons perform the surgery.<sup>93</sup> This finding is also confirmed in a systematic review.<sup>94</sup>

High quality in surgery also confers an important advantage on long-term, usually oncologic, results such as disease-free survival and quality of life. Therefore, high quality in surgery should have a dramatic effect on indirect cost, although data here are missing. Evidence from a systematic review of the economic impact of centralization provide strong evidence that increasing surgeon volumes are associated with cost reductions. For example, 1 study demonstrated that centralization was cost-effective with an incremental cost utility ratio of \$5029 (€3616) per quality-adjusted life year gained (QUALY).<sup>94</sup>

Although health care delivery may not compare well with the manufacturing process in industry, we can learn from industrial experience with centralized versus decentralized manufacturing. Centralized manufacturing is associated with lower costs, higher material turnaround rates with a more efficient production schedule, more consistent production, and better use of limited resources, including infrastructure and personnel. The advantages linked to decentralized strategies are higher flexibility, greater customization, proximity to customers. Lower tier managers in decentralized manufacturing companies often have more responsibilities and are consequently more motivated and creative. Translating this to medicine, it becomes apparent that centralization is unavoidable, but

particular attention must be given to preserve personalized relationship, not only with patients but also among the personal. Thus, it is tempting to conclude that special resources should be allocated to these potential shortcomings of larger institution.

### Patient Perspective on Centralization

Building on the previous risk of centralization, one well-recognized disadvantage is an increase in travel demands, thus a perceived limited access to high-quality care with greater distance from family and friends. The involvement of patients in the centralization process is therefore a key component for success. A Swedish study analyzed the patient's perspectives on centralization and identified quality of care (outcome) as the most important factor to convince patients.<sup>95</sup> Additional factors such as a well-functioning care pathway, individualized care-plans, continuity of treatment with local providers, accessibility for contact and information, involvement in the care process, and limited waiting time are very important for patients' satisfaction. In another study from the UK, patient's preference to be treated in a high-volume center was based on a lower risk of complications and death, and a better access to multidisciplinary teams.<sup>96</sup> In the same study, patients were willing to travel on average 75 minutes longer in order to reduce their risk of complications by 1%, and over 5 hours longer to reduce risk of death by 1%. According to US studies, for many patients, the influence of outcome data on patients' hospital selection might be overestimated.<sup>97,98</sup> In case of centralization travel patterns,<sup>99</sup> socioeconomic status (eg, household income) of patients and race/ethnicity<sup>100</sup> must be addressed to reduce and avoid health disparities in multicultural countries, such as repeatedly noted in the USA.<sup>50,101</sup>

### Surgeons' Perspective on Centralization

Surgeons in the Netherlands gained experience over the past 2 decades for volume-based policies, with a good acceptance that more volume leads to better quality.<sup>102</sup> They, however, critically emphasize that hospital volume is more a surrogate marker for the quality of the infrastructure and processes, rather than the performance of individual surgeons. Many surgeons complained about the arbitrary nature of the centralization process due to the under-representation of surgeons in the national committees that define the volume bar. Criticisms were also raised that volume bar levels were set without sufficient evidence. Furthermore, several committee members had obvious conflict of interest, as they were employees of high-volume centers. Another complaint related to the “gate to surgery”, that is, indications, which became a bit wider to reach the requested volume threshold. Most of interviewed surgeons also criticize the attitude of health insurers for misusing volume discussions and putting some pressure on health care providers. The “Take the Volume Pledge” campaign in the USA in 2015 tried to promote restriction of 10 surgical procedures to hospitals with minimal annual volume thresholds. In the light of the modest ambition of this campaign, the response of the surgical community against such a strategy was disproportionally strong.

Patients' and surgeons' perspectives on centralization are in most of the investigated studies reflecting similar interests and concerns. Perspectives relate on surgery and do not necessarily apply to other treatment options (such as chemotherapy), which may be provided also in a local network hospital.

## DISCUSSION

There is currently overwhelmingly evidence in favor of centralization for complex surgical procedures. Considering the least biased perspective, that is, the patient perspective, centralization makes full sense because it offers the best chance for high quality of



health care for both short and long-term outcomes. The available literature on centralization as well as the views from local and national patient associations and most health care payers are consistent with the Delphi process from ESA members, unambiguously favoring centralized institutions for complex health care delivery, which represents only about 2% to 3% of all surgical procedure. In truth, it would be difficult to find anyone, unless living on the moon for the past 30 years, who could challenge that competence relies on experience and adequate resources, that is, centralization.

Therefore, the question arises why centralization so poorly applies to medicine, and in particular, why most countries failed to implement clear policies for centralization. Health care providers, and many doctors and nurses, who work close to patients with complex diseases remain frustrated. Although many countries have policies or even laws to secure concentration of rare and complex cases at local or national levels, efficient implementation is notoriously not realized, possibly because too many interests are involved. Hospitals or even states are even using legal ways to reverse or slow down decisions at the national level for centralization to preserve prestige, often based on history and personal or institutional interest. The patient is sadly not in the equation. The authors of this article, mostly from the European academic world, are standing up here to make a plea that we should follow the “Hippocrates oath” respecting 1 predominant perspective, that is, the patient. In theory, this should be easy to understand because each of us, with probably no exception, will become a patient one day!

So, assuming that centralization is the right concept, how it should look? The aim is to secure competence in optimally treating a patient with a complex disorder in a holistic way, rather than just considering the ability to be able to perform complex procedures. With this objective, it becomes obvious that focusing just on the minimal number of procedures per hospital or per surgeon to qualify for delivering complex surgeries becomes trivial. The criteria to qualify as an accredited center of excellence should focus on the disease, rather the number of specific procedures; this is to secure the optimal delivery of care and importantly the adequate choices for competitive therapies. The role of a properly structured multidisciplinary team is paramount for such decision-making and appropriate expertise must optimally be available at centralized centers all around the clock and the year. For example, failure to have an experienced interventional radiologist on a week-end to treat a patient with acute bleeding following a pancreato-duodenectomy may result in a death. Another example is the unavailability of an interventional gastroenterologist on a holiday day, which may result in the placement of a cumbersome percutaneous drainage instead of an ERCP stent in a patient presenting with acute cholangitis.

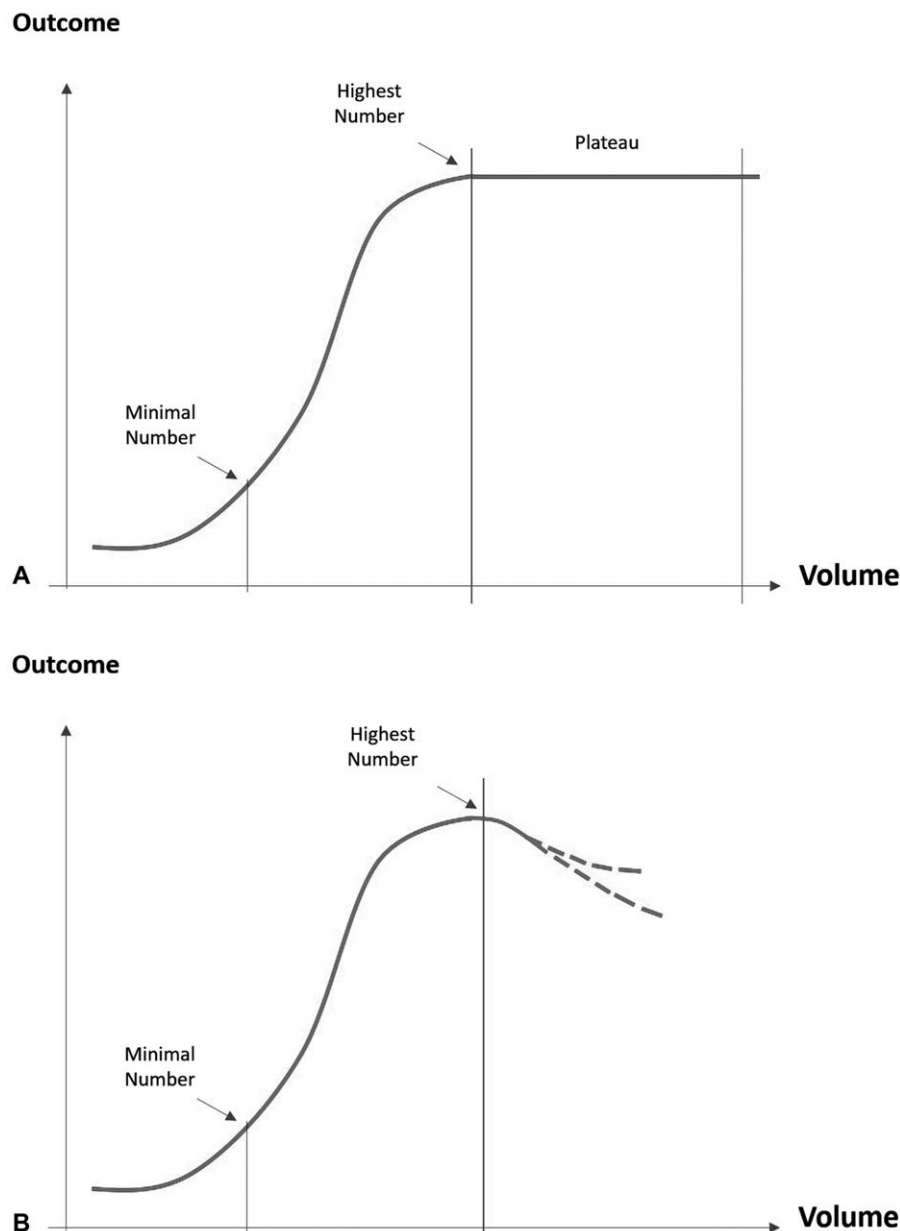
Having the appropriate setting and staff from the medical perspective still does not secure quality of care. There is a need for quality control, which remains one of the major challenges for data collection and it can be difficult to know which metric to use. Currently, unconvincing data in many countries offer solid arguments to those who still lobby against centralization. For example, an academic public hospital reporting poorer outcome than a pure “for profit” institution targeting a private clientele would claim that they deal with higher risk populations. Then, an endless “risk adjustment” debate may ensue, with misleading data typically used by “for profit” institutions, which put more emphasis on marketing, to convince the decision makers about their superior results. Probably, the one with the most convincing marketing tools may win. Do we want this world in highly specialized medicine? Certainly not from a patient’s-oriented perspective! For this purpose and credible comparative measures, a newly benchmark concept was developed<sup>103,104</sup> targeting relevant outcome parameters gathered in well-defined low risk groups to prevent misleading comparisons among heterogeneous populations. For example, a large academic center reports a 35% severe complication rates (eg, > grade III<sup>90</sup>) on their complex liver resections, while a “competitive” smaller institution claims 12%. Unable to understand the difference, most patients may select the center with the appealing data, which in reality limits their activity to a low risk cases, and thereby further contribute to the attractive statistic. In this scenario, the patients are not aware that many higher risk cases have been turned down to secure optimal outcomes. Therefore, an easy way to objectively assess those 2 institutions is to compare the benchmark (low risk) cases to get meaningful and easy to interpret information. The proportion of the benchmark cases also readily provides information of the risk-taking from specific institutions. Not surprisingly, recent studies have nicely highlighted that centers coping with difficult cases also do better with the benchmark cases.<sup>103</sup> This novel approach may highly benefit patient-oriented parameters, or newly called value-based medicine.<sup>105</sup> As accreditation would look at the disease as a whole, quality control should also encompass the whole process from prevention, diagnosis to treatment, complications, and survival (and not simply an operation and its survival). It is obvious that centralization that would only create better results of pancreatic surgery at the expense of conservative surgical indications or long waiting times resulting in more drop-outs or inoperable cases, etc, would be detrimental to the patient.

Aware of the current analysis, members from ESA including at least 1 from each European country and USA and Canada went through a Delphi process to propose 12 recommendations (Table 3). The focus was to propose simple statements applicable to various

**TABLE 3.** Twelve Recommendations for Centralization

- (1) Definition should be based on disease (eg, pancreatic cancer) or on organ systems (eg, complex HPB diseases) rather than a procedure (eg, esophagectomy or pancreatectomy).
- (2) The planning is based on minimal numbers of cases per center and also well distributed among various regions, considering population and cultural specificities, in a country.
- (3) Planning should include at least 2 centers per country to secure choice and competition (except for small countries and very rare diseases).
- (4) Appropriate resources must be secured with proper evaluation of available infrastructure and personnel.
- (5) Centers must offer fully functioning multidisciplinary teams (MDTs) of specialists capable of tackling all aspects of the diseases all the year around.
- (6) Centers must be linked to a network of hospitals to secure adequate referral and follow-up.
- (7) Specifications of centralization must be legally enforced for adherence to specifications applied at the local and regional level and for private and nonprivate hospitals.
- (8) The process for centralization must be accompanied by mainstream media activities to secure appropriate awareness of the population.
- (9) Centers must have an externally audited database and are actively involved in clinical studies (including RCTs) and should be encouraged to contribute to laboratory research along with basic scientists.
- (10) Quality control must be accompanied by international benchmark comparative studies.
- (11) Equal accessibility to centralized health care should be monitored.
- (12) Centers must be involved in surgical education, and secure specialized training as well as allowing rotation of “general surgeons.”





**FIGURE 1.** The relation volume; improved outcome may follow 2 scenarios. Outcome parameters may follow a plateau after reaching a certain threshold (A) or may be associated with poorer results such as increased waiting time, poorer postoperative course, or even mortality (B).

health care, political, and economic systems. From the 12 statements, a few may remain open to debate such the need for centralized institution to engage in research. Considering that the ESA is a society for the academic leaders in surgery in Europe, it is no surprise that a recommendation for clinical research is made, and research is a society value, which might also be a purpose for centralization.

Such a comprehensive look at centralization is inherently associated with some limitations. Volume-outcome studies are mostly observational, retrospective, often follow a time-series design, and are based on administrative data collected for other purposes. Many of these studies are from different health care systems with a great variety in demographical, geographical, and epidemiological factors and standards of care. NSQIP studies underline the major limitations of administrative reviews. Caution should also be taken by the fact that centers reaching very high

volumes may face poorer outcome, as shown for complex surgeries and in centralization in other fields such as manufacturing industry (Fig. 1).

In summary, this task, performed on behalf of the ESA, clearly establishes the importance of centralization to offer better care in patients suffering from complex diseases requiring special expertise and costly technology. The 12 recommendations may serve as a basis for discussion in various areas to improve health care delivery.

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## DISCUSSANTS

### Mario Morino (Torino, Italy):

On behalf of all of the members of the ESA, I would like to congratulate the authors on this very important analysis of centralization in digestive surgery within Europe.

Centralization implies surgical specialization, and there is no doubt that this has been a trend in surgery for the past 70 to 80 years. General surgeons used to perform cardiac surgery, urology, vascular surgery, etc. Now, we are left with the digestive tract and HPB.

Therefore, my first question is: Where and when should this process stop? Should it be limited to the fields in which we have the most robust data – esophageal and pancreatic surgery – or should colorectal surgery also be included? If so, what will remain within the field of general surgery?

In my opinion, the second and more relevant question is as follows: Will this process of centralization have some negative effects or drawbacks? In the manuscript, you stated that “...no study identified a negative effect of high volume surgeons on the outcome.” Personally, I believe that the problem is that these studies consider only 1 side of the coin: While the quality of complex surgery will certainly improve, is there a risk of endangering the quality of standard general surgery? In order to reduce the rate of pancreaticoduodenectomy mortality by 1% to 2%, will we increase, for example, the rate of bile duct lesions after cholecystectomies performed by general surgeons, who will no longer have the chance to operate on the liver and pancreas? What will happen to the quality of emergency surgery in low-volume hospitals, where elective surgery for stomach, pancreas, colorectal pathologies will disappear? How will this influence the training and curriculum of a low-volume surgeon operating in a low-volume hospital?

A second drawback of super specialization concerns the introduction of new technologies. There is no doubt that numerous advancements in the history of surgery were possible thanks to eclectic surgeons and “contamination among specialties.” Laparoscopic surgery is the more recent example of this. Colorectal surgeons started to perform laparoscopic resections 20 years later than general surgeons, and as was highlighted in one of the previous presentations at this congress, it would be impossible for a pancreatic surgeon to become proficient in laparoscopic pancreas surgery without having acquired a large amount of experience in a different domain of digestive surgery, such as colorectal or bariatric surgery. Could you please comment on this point?

Concerning the Delphi process, I think that the results are biased by the fact that the process was limited to ESA members or surgeons working in high-volume academic centers, which would benefit from centralization. In order to obtain more reliable results, I invite the authors to reproduce this survey with a wider population of surgeons, who are representative of all aspects of our practice.

Centralization is a crucial issue for the future of general surgery. As I said in my Presidential lecture, the future is unwritten, but this paper will certainly be very useful in trying to shape it.

### Takeshi Sano (Tokyo, Japan):

Thank you very much for giving me the chance to comment on this remarkable work. In Japan, centralization is very slow, as I will tell you later. So, I learned a great deal by reading this comprehensive study, which covers all of the issues of surgical centralization. The study volume is enormous, and I genuinely respect this painstaking work.

As was easily expected, or having even exceeded expectations, the difference among the European countries was significant in almost all aspects. As you listed in Table 2, there are many obstacles to centralization in all levels of patients, health care providers, payers, and politics. When we look at this list of obstacles, centralization seems to be an impossible dream. Nevertheless, you have shown a strong intention toward centralization, which should be praised.

First, your paper repeatedly mentions that the minimal numbers of cases per hospital or surgeon are difficult to define, due to a lack of acceptable evidence, and thus, should not be the principal requirement for centralization. In the Delphi process, you also seem to have carefully avoided the question relating to the number of necessary cases. Nevertheless, in the final recommendation, you state, “The planning is based on minimal numbers of cases per center.” Are you going to propose some standard numbers in the near future, based on further studies, or are you leaving this decision to authorities in each country?

Second, you compared the effects of hospital volume in esophageal cancer surgery between specialized centers in the UK and USA. The large difference is seen in hospital volume, but still, the mortality rate was not very different – just 4% and 5% – though you stated the difference was significant. I think that this needs further explanation.

Third, after publishing these recommendations, what do you expect to happen in each country? Obviously, these recommendations are from the viewpoint of academic high-volume center surgeons, and are not the end of the study, but rather the beginning of ideal centralization. You should expect counterarguments or disagreements from other sectors. I wish for you to successfully continue working toward the goal.

Finally, in Japan, we have recently started a national clinical database system (NCD), which covers more than 95% of major surgeries performed in the country. For example, in 2011, 5300 esophagectomies were performed in 713 hospitals, and 20,011 total gastrectomies were performed in 1623 hospitals. So, these are not at all centralized. According to the Japanese policy, as emphasized by the government and academic societies, people should be equally treated wherever they live. However, this NCD also showed that, especially in hepatobiliary pancreatic surgeries, higher volume centers have an apparently lower morbidity and mortality rate. We have just started the centralization discussion. Cancer treatment is especially important in Japanese society, which is now the society with the oldest population in the world, and the government has set up some criteria to recognize cancer hospitals in each region. Currently, we have 401 such hospitals, and the criteria include the number of cancer surgeries, chemotherapy, MDT, ICU, palliative care, and so on. However, this is simply a kind of service offered to the Japanese people, and cancer patients are not required to follow this. They can be treated anywhere they like, without any restrictions. In short, we are starting or trying to establish some centralization, but it will probably take a long time. Thank you.

### Ronald W. Busuttil (Los Angeles, USA):

First, I wish to thank Professor Pierre Clavien for asking me to make a few comments on this important Special Lecture, and specifically, from a US perspective. As presented in the talk, centralization of surgical care has been discussed and attempted in many countries, as it



was first introduced more than 4 decades ago. However, it is only in the past 5 to 10 years that its benefit to patients, outcomes, education, and cost reduction are now being realized.

The acceptance of centralization of surgical care is, in many cases, dependent on the Payer System, degree of complexity of the surgical illness, and specific type of insurance coverage, which is particularly pertinent in the US. Perhaps, this is one of the reasons for which centralized care has not taken on the same kind of expansive acceptance as it has here.

Patients undergoing tertiary and quaternary procedures appear to have been the greatest beneficiaries of centralization, showing improved outcomes and more cost-effective results. Transplantation is one of the unique examples of tertiary and quaternary care, which has unequivocally shown the benefits of centralization on patient outcomes and the reduction of resource utilization.

If one considers liver transplantation, which is acknowledged as one of the most complex quaternary procedures, due to illness severity, technical complexity, and the frequent association of severe comorbidities, then there is no question that limiting the procedure to only highly qualified centers in the US has resulted in improved outcomes and a decreased cost of care. In the US, the centralization of surgery of all solid organ transplantation has directed patients with a higher risk and higher complexity to centers, which provided over 50% of all solid organ transplants. In addition, they are the facilities that provide care for our complex patients, such as >50% of trauma victims, burn victims, and ICU bound pediatric patients. Commensurate with their outstanding care, they provide unique opportunities for research, academic advancement, and training in the future leaders of surgical care.

Another benefit of centralizing care of transplant recipients, which we have just realized, is the increasing use of free-standing organ retrieval centers. One of the first in the US was in St. Louis, but now they are expanding to other cities, such as Philadelphia, Denver, Chicago, and Los Angeles. Performing the organ harvest at a central facility has been shown to decrease ischemia time, offer a more consistent protocol in organ procurement, and reduce costs by 30% or more.

Transplant surgery has not been the only discipline to show an encouraging trend in both patient outcomes and cost-effectiveness. A recent study from the University of Barcelona, authored by Professor Prades and colleagues, showed that the centralization of management of patients with rectal cancer surgery resulted in a better quality of care and unparalleled adherence to clinical guidelines. There are also other examples of this phenomenon in patients undergoing complex pancreatic, cardiac and aortic surgery, where the results after centralization in the US are superior and more cost-effective for the patients and providers. The efficacy and improved patient care from centralization has indeed been demonstrated, and in my opinion, will continue to expand in the United States in the future, although at a slower pace than it has in Europe.

I would like to know what the guidelines and requirements are for a specific hospital and its surgical providers to become a center of excellence. Obviously, experience and documented patient outcomes are paramount. However, are there specific guidelines, relating to hospital and professional cost, which have to be taken into consideration? This is certainly an issue in the United States.

I would like to thank the association for the privilege of commenting on this important paper.

### Response from Pierre-Alain Clavien (Zurich, Switzerland):

I would like to thank the 3 discussants for reading our paper as well as commenting on this complex and controversial topic. The Council of the ESA has selected the issue of centralization with the

intention of investigating country-specific policies and applications, in order to critically review available data, and eventually, propose recommendations.

First, I would like to address our President's challenge – and correspondingly, Professor Sano's third comment – as to whether our opinion is biased, as we mostly represent the academic world, where centralization largely occurs. I believe that the ESA, which is one of the most prestigious academic associations of specialized surgeons, must not only be actively engaged in this discussion but also present a strong, unified voice concerning this topic. Importantly, however, our recommendations must be exclusively based on the patients' perspective. In the discussion of the manuscript, we list strong arguments calling for caution when considering other perspectives, which logically intend to preserve interests that distance themselves from the best available care for patients. For example, surgeons or hospitals represent major factors that prevent effective centralization. Typically, national societies of general surgeons are opposed to the process of centralization, as many members may perform few complex procedures each year, and actively lobby against centralization at their respective health authorities, claiming that the good results they obtain render it unnecessary.

Opponents of centralization have used the lack of reliable data at national levels, which demonstrates the correlation between center volume and outcome, as their main argument against it. Politicians also tremble, when it comes to the idea of reducing activities at local hospitals, even when this would only implicate a few cases per year, as their main concern is to be re-elected. Again, embedded in the increasingly accepted notion of “value-based medicine,” which focuses on the best interest of the patients, the concept of centralization becomes straightforward. It is common sense that patients greatly benefit when complex diseases are handed over to experts.

The point about “hyper-specialization,” or when to stop the process of specialization, as well as the possibility that this may have a negative impact on the training of general surgeons, is indeed crucial and must be addressed at each country level, in order to secure a balance between general surgeons and specialists. It is important to keep in mind that complex procedures justifying centralization represent less than 5% of all of the cases within general surgery. Thus, the impact on hospital or surgeon volume is moderate at worst. The process of centralization must be done in networks, as outlined in the paper. If hospitals are scattered across different regions, then there is a need to establish solid links with other hospitals of different sizes, so that patients can be transferred and have an adequate work-up and follow-up, when needed. The rotation of general surgeons at specialized centers, particularly during training, is highly advisable.

Another point is that ESA recommendations for centralization focus on the treatment of a disease, rather than a specific procedure. For instance, centers should cover pancreatic cancer with all associated therapies, rather than only concentrating on Whipple operations. Patients do not simply need a competent surgeon but also a competent hospital with other specialists available. A competent center must manage complex diseases by having an interdisciplinary team of experts available around the clock.

Professor Morino emphasizes the role of cross-fertility in novel technologies among various fields of surgery. This is also an important point, which may justify the clustering of several complex diseases at the same centers (eg, cancer of the esophagus, pancreas, and rectum at 1 tertiary center). However, I believe that robotic surgery will soon become a common practice in many fields, rendering cross-fertilization less imperative. Finally, exchanges covering nothing less than the world through innovative connectivity technologies will soon replace cross-fertilization at simple centers. So, I must admit that I do not share this concern.

Professor Sano, you comment that centralization seems to be an “impossible dream.” As discussed in the paper, if we eliminate the obstacles and continue to focus on the patients, then this dream may become a reality. Potential negative factors associated with centralization, such as access to information and contact details, lengthy waiting times for highly specialized surgery, and continuity of care with local providers, must be carefully addressed. For example, Dr Vonlanthen addressed the issue of a patient’s willingness to travel, which requires patient education about the benefits of being treated at a specialized center. The Delphi exercise identified that the media must also participate in the process of centralization by diffusing proper information.

Your last question, Professor Sano, concerns the comparison of mortality rates of esophagectomies in the USA and the UK. In the UK, we had around 7500 esophagectomies in 66 centers, whereas in the USA, 6000 cases were treated in 775 centers! There is a significant difference between the 2 countries, with regards to overall mortality rate (4% for UK vs 5% for USA). Now, if you restrict the comparison to the highest volume centers in the US, the mortality rate falls to 2.1%, which is better than the high-volume centers in the UK. This is an argument in favor of centralization.

Regarding your question about the Delphi process, there were indeed several statements, which require adjustment. For example, you asked how we should select the centers for centralization. Only taking volume into consideration is clearly insufficient. The consensus tends to recommend catchment areas and minimum numbers, although a uniformly acceptable figure for the number of cases could

not be identified. There is also a need to clearly define which resources (eg, infrastructure, materials, and personnel) are needed for a center to be considered as high-volume. However, the decision about how many centers there should be and their location remains country-specific. For example, Switzerland – a small country with 8 million inhabitants and 3 national languages – would benefit from a distribution that respects the cultural issues at play within the country. In the end, if we use value-based medicine parameters, patient outcome that is grounded on a disease, and not only surgery, must be closely monitored.

Professor Busuttill, I would like to thank you for also presenting the US perspective and the example of transplantation. With regards to your last question, as I just discussed, it is clear that a center of excellence cannot qualify as such, if patient outcomes are poor. There is a need for international benchmark comparisons, which we emphasized in the Delphi-based recommendations. Regarding resources, we agree that this is the responsibility of the health authority or government within the country. If politicians agree to establish a center of excellence, they must be responsible for providing the hospital or center with adequate resources. Indeed, it is our responsibility to define what a center of excellence encompasses by presenting guidelines or minimum requirements, such as the ESA recommendations, in order to secure proper care.

Again, I wish to thank our President and both renowned discussants from Japan and the USA for their input, and the association for trusting the group from Zurich to coordinate this special lecture among all ESA countries.